Open Access
J. Glob. Innov. Agric. Sci., 2023, 11(4):533-541
ISSN (Online): 2788-4546; ISSN (Print):2788-4538
DOI: https://doi.org/10.22194/JGIAS/23.1218
http://www.jgiass.com

The economic constraints of adopting renewable energy in farming systems

Jawad A. Al-Dalaeen

Department of Financial and Administrative Sciences, Karak University College, Al -Balqa Applied University, Jordan
Corresponding author's e-mail:jawad.papers@gmail.com; jawad.dalaeen@bau.edu.jo

The shift to renewable energy is considered one of the policies that encourage agricultural production and preserve the environment. This paper investigates the constraints that affect the adoption of renewable energy sources in developing countries. A questionnaire was designed to collect the data. The questionnaire's validity and reliability were measured. The questionnaire was distributed on 150 farms. The relative importance index was calculated for the different constraints and the structural equation modeling was used to measure the effect of different factors on the adoption of renewable energy sources. The results showed moderate tendencies of farmers to adopt renewable energy sources. The weight of the different constraints was very close showing that legal and economic constraints were in the first position, followed by infrastructure readiness, installation costs, and maintenance requirements.
Keywords: Renewable energy, economic constraints, legal constraints, installation constraints, economic returns, adoption tendencies, farm size.

INTRODUCTION

Energy forms a basic input in agricultural activities. The use of energy is different from one agricultural activity to another. This determines the extent of energy importance according to the agricultural sector (Babatunde, *et al.*, 2019). The cost of energy in some agricultural sectors is very high due to the continuous need for energy in the production process (Zimmer & Marques, 2021). The cheaper alternative sources of energy became a target in agriculture both to reduce production costs and minimize environmental pollution. The utilization of renewable energy sources namely solar radiation is surrounded by many constraints and is not open to the public depending on the policies of countries.

The adoption of renewable energy policies is different from one sector to another and from location to another depending on the position of the public electricity networks (Roberts *et al.*, 2023), permission needed, the infrastructure of the farm, and many other constraints depending on different cultural, social and economic factors. Despite the variations of the constraints controlling the shift to renewable energy, still high similarity of these factors can be found among the different countries.

The other interest of the use of renewable energy is the accomplishment of the sustainable development goals (SDGs). The energy indicators form about one-third of the SDGs indicators. To improve the accomplishment of the SDGs in the energy sector, the concentration should be on the sectors that consume more energy from traditional sources (Santika *et al.*,2019). Agriculture is one of these sectors which should receive higher attention in the current years to protect from climate change and increase the concentration on renewable energy sources.

The concern of the constraints that affect the adoption of renewables in developing countries lacks a deep investigation to alleviate these constraints and increase the participation efforts of the use of renewable energy in different farming sectors. This study investigates the constraints that face farmers in adopting renewable energy sources. The studied constraints included the legal and installation costs, infrastructure readiness, maintenance, economic returns, and adoption of technology constraints.

Background: Renewable energy is considered the source that will save the world and the environment at the current time and future. On the other hand, renewable energy is found to help improve the economic condition of the public and the agricultural sector in private (Hernandez-Escobedo *et al.*, 2023). The tendency to adopt renewable energy sources is dependent on the policies and facilities introduced to encourage farmers (Tsangas, *et al.*, 2022). The benefits of the adoption of renewable energy are dependent on the extent of using energy in the production process according to the

Dalaeen, J.A.D. 2023. The economic constraints of adopting renewable energy in farming systems. Journal of Global Innovations in Agricultural Sciences 11:533-541.
[Received 20 Nov 2023; Accepted 18 Dec 2023; Published 22 Dec 2023]

sector. These conditions create different constraints that affect the adoption of renewable energy in different countries especially in developing countries.

The constraints to using renewable energy are different from one country to another. The constraints facing the adoption of renewable energy range from the base which affects the process in general to the private constraints related to the farmers themselves. The most serious constraint related to the adoption of renewable energy is related to the policies and regulations that control the adoption process. Pascaris *et al.* (2021) raised the political dimension as the first important one to control the adoption and distribution of renewable energy. Abban and Hasan (2021) believe that the political dimension is considered the predominant for the distribution of renewable energy to replace traditional sources. The policies should support and encourage farmers to use renewable energy in the production process (Makki & Mosly, 2020). The policies and regulations should consider the incentives that encourage farmers to use renewable energy sources (Meya & Neetzow, 2021). The policies and regulations would help improve the farmers' acceptance of renewable energy (Karbo, *et al.*, 2022). The financial incentives are considered one of the first initiatives toward renewable energy sources.

Infrastructure readiness is considered the second basic effector on the adoption of renewable energy sources. Choobchain and Farhadian (2018) investigated the barriers to the adoption of renewable energy. The infrastructure was one of the major issues that faced the adoption. The lack of served infrastructure by the government increases the cost of installing renewable energy systems. The location of the farm is considered one of the limitations of using renewable energy sources because it should be connected to the public electricity networks. Morris and Bowen (2020) related the readiness of infrastructure to the cost requirements to install the infrastructure needs.

The installation cost of renewable energy units is considered very high for farmers (Afsharzade *et al.*, 2016). Another constraint related to the running cost of the renewable cost. Farmers feel that the construction of renewable energy systems will increase the financial overburden of the farm. The initial costs and running costs decrease the rural social acceptance of renewable energy sources (Devine-Wright & Wiersma, 2020). The farmers believe that they should use external sources for all the stages of dealing with and managing the renewable energy system. Some farmers considered this as an extra effort they should practice to meet the requirement of the adoption of renewable energy systems. The adoption of renewable energy systems is considered innovation and change for farmers. Consequently, the economic dimensions of adopting renewable energy systems are considered part of the change which faces resistance due to the financial overburden the farmers expected to face in managing these systems (Simpson, 2018).

MATERIALS AND METHODS

The objective of this is to investigate, the economic constraints that affect the adoption of renewable energy by farmers in Jordan. The literature was collected and utilized to investigate the problem in this field. According to the literature, four areas were recognized including the legal constraints, the installation costs, infrastructure readiness, the maintenance, and economic returns. Based on the literature, a pilot study was designed using direct interviews with 10 farmers from different farming sizes to figure out the constraints that may face the adoption of renewable energy in Jordan. The pilot interviews were aimed at matching the international directions for renewable energy through farmers' views and reaching more views about the adoption of renewable energy sources in Jordan. Table 1 shows the summary of constraints reached through literature and the interviews to represent the case of Jordan.

Figure 1. The path of the constraints affects the adoption of renewable energy.

The questionnaire was designed based on the constraints reached in Table 1. The questionnaire was composed of 7 parts. The first part was concerned with collecting data about the socio-demographic characteristics of the farmers (age, years of experience, education, position and monthly income from agriculture, and type of farming). The rest parts were designed to collect information about legal constraints, installation, infrastructure, maintenance, economic returns, and adoption tendencies. The studied variables were determined according to the pilot study which investigated the primary difficulties and barriers that face the adoption of renewable energy sources. These variables helped reach the objectives of this research. Likert scale using 5 points was used to collect data and measure the farmers' agreements about the different constraints (strongly agree =5 to strongly disagree=1).

To accomplish the objectives of the study, due to the lack of a systematic framework of farmers and to include different farm sizes, the purposive sample was used. The purposive sample targeted the farm that adopted renewable energy sources. About 150 farmers were selected from different agricultural areas including Ghor and Uphill areas. The sample covered most of the farms that own renewable energy in the studied areas. The included farms represent different agricultural activities. The data was collected in person and structured small interviews were conducted from the same visited areas including different farmers from different

Table 1. The economic constraints included based on literature and interviews.

Legal Constraints	Installation Cost	Infrastructure readiness	Maintenance	Economic returns	Adoption tendencies
- Complexity of getting legal permission - The current conditions to satisfy the installation requirements - The form of renewable agreed upon by law - The current legal frame is not suitable	- High input material cost - High installation cost - Incentive to invest - Limited financial support	- The area consumed for cells is high - Scale of the farm - Farm location is suitable - Technological barriers	- The running cost is high - High cell replacement cost - Self-experience of systems	- Improve economic returns - Increase farming efficiency - Increasing the practiced activities	- Willing to adopt - Increase investments - Innovation in farming - Adopt more technology in farming - Type of farming

farming categories. The data was collected from Jan 2022 to Sep 2022. The long period is a result of the distant locations of farms and finding the farmers' owners to respond.

The questionnaire validity and reliability were executed by studying a pilot sample composed of 30 farmers. The collected notes and difficulties were corrected in the questionnaire to ensure the right understanding of the different items. The questionnaire reliability was analyzed using Cronbach's alpha. Table 2 shows the reliability analysis results. The results showed that the values of Cronbach's alpha were more than 0.6 which is acceptable in such studies. The collected data was entered into SPSS Ver. 26 for analysis. AMOS was used for the structural equation model analysis. Descriptive statistics was used to measure trends. The frequencies and percentages were used to measure the distribution characteristics of farmers, while means and standard deviations were used to measure the farmers' trends for the economic constraints of using renewable energy in their farms. The structural equation modeling was used to study the association of the different constraints to adopt renewable energy sources with each other and its effect on the tendency of farmers to adopt renewable energy sources (Hoyle, 2016). The results of reliability analysis using Cronbach's Alpha show that the value is more than 0.6 which reflects the reliability of the questionnaire (Holcomb & Cox, 2018).

Table 2. Reliability analysis using Cronbach's Alpha.

Constraints	Cronbach's alphas	Acceptability
Legal constraints	0.728	Acceptable
Installation cost	0.721	Acceptable
Infrastructure readiness	0.725	Acceptable
Maintenance	0.619	Acceptable
Economic returns	0.734	Acceptable
Adoption tendencies	0.753	Acceptable

The relative important index (RII) was used to calculate the extent to which the constraints form to work as a barrier in adopting renewable energy in agriculture in Jordan using equation (1):

$$RII = \Sigma WiFi/A*N = 1F1+ 2F2 + 3F3 + 4F4 + 5F5 / 5N \quad (1)$$

Where: i-response category index, Wi- is the weight given by the farmer, Fi- is the frequency of farmer for each weight, A- is the highest weight, and N – is the total number of farmers. The range of RII is 0 to 1 and 0 is not inclusive.

The correlation between the independent variables (legal constraints, installation cost, infrastructure readiness, maintenance, and economic returns) and the dependent variable (adoption tendencies) was calculated. Structural equation modeling (SEM) using AMOS (Ver. 24) was used to calculate the effects of the different variables.

RESULTS

***Socio-demographic characteristics*:** The socio-demographic characteristics show that most of the sample respondents are of moderate or high ages. The dominant farmers' age ranged from 46 to 50 years (44.0%), followed by 30-45 years (27.3%). The ages less than 30 years percent was (14.0%) and more than 50 years (14.7%). The dominant education of farmers is B. Sc. with percent (58.0%) followed by the higher studies (35.3%). Most of the experiences of the farmers were more than 5 years. The dominant experience was more than 10 years (63.3%) followed by 5-10 years (30.7%) (Table 3).

***Legal constraints*:** The assessment of legal issues that form a constraint to utilizing renewable energy sources was moderate (3.63±0.55). The legal constraints were in the second position according to farmers' evaluation (Fig. 2). The legal permissions to use renewable energy form the highest constraint for farmers (3.85±0.70). The second rank of legal constraint was for the current conditions to satisfy the installation requirements (3.56±0.83). The agreement of the form of renewable energy by law was the third constraint

(3.55±0.81). The farmers agreed that the current legal frame is not suitable to encourage the use of renewable energy by farmers (3.45±0.85) (Fig. 3).

Table 3. The relative importance index of the constraints.

Constraint	RII	Rank
Legal Constraints	0.73	A
- Complexity of getting legal permission	0.77	1
- The current conditions to satisfy the installation requirements	0.71	2
- The form of renewable agreed upon by law	0.71	3
The current legal frame is not suitable	0.69	4
Installation cost	0.71	C
- High input material cost	0.75	1
- Limited financial support	0.73	2
- High installation cost	0.69	3
- Incentive to invest	0.69	3
Infrastructure Readiness	0.72	B
- The area consumed for cells is high	0.74	1
- Technological barriers	0.71	2
- Scale of the farm	0.70	3
- Farm location is suitable	0.70	3
Maintenance	0.71	C
- High cell replacement cost	0.71	1
- The running cost is high	0.70	2
- Self-experience of systems	0.70	2
Economic returns	0.73	A
- Improve economic returns	0.74	1
- Increase farming efficiency	0.72	2
- Increasing the practiced activities	0.69	3

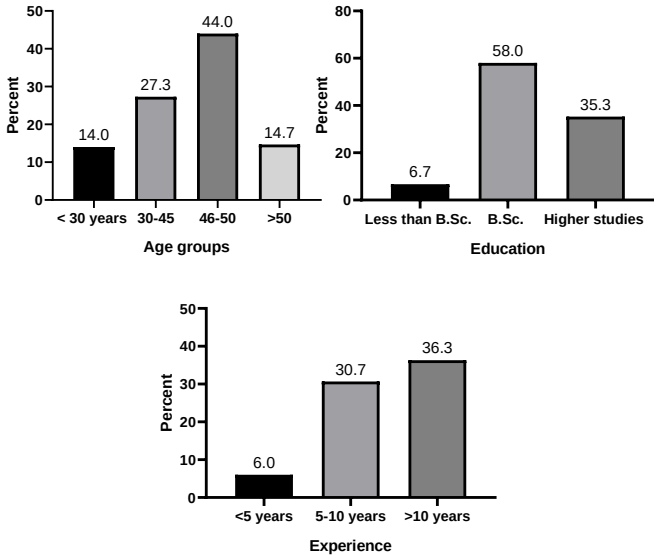

Figure 1. The distribution of farmers' sociodemographic characteristics.

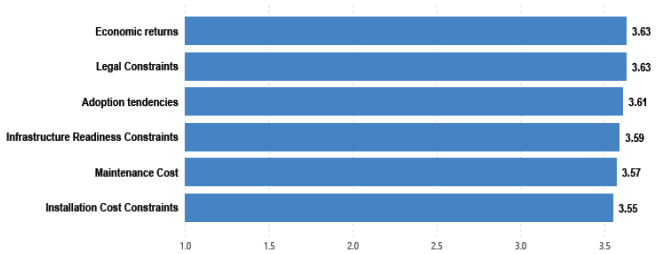

Figure 2. The trends of the different RES adoption constraints among farmers.

***Installation cost*:** The assessment of the installation cost as a constraint was moderately assessed (3.55±0.58) taking the last constraints in order (Fig. 2). The high input material cost was the first barrier to the adoption of RES (3.74±0.85), followed by the installation costs (3.47±0.83). The third constraint was the limited financial support the farmers receive to use renewable energy sources (3.47±0.84). The last assessment of the constraints was for the incentives given to farmers to invest in renewable energy sources (3.45±0.83) (Fig 3).

***Infrastructure Readiness*:** The results showed that the assessment of the infrastructure readiness as a constraint was moderate (3.59±0.56) as the fourth adoption constraint (Fig. 2). The area needed for the solar cells is considered the first constraint (3.69±0.81). The second constraint was for the technology barriers (3.57±0.82). The third constraint was for the scale of the farm (3.49±0.77) and the last constraint was for the farm location (3.49±0.85 (Figure 3).

***Maintenance Costs*:** The assessment of the maintenance costs as constraints was moderate with the fifth order among others (3.57±0.51) (Figure 2). The first constraint was the high cost of solar cell replacement (3.53±0.77). The second constraint is related to the self-experience of the renewable energy systems (3.51±0.86) and the third constraint was the high running cost of the renewable energy systems (3.50±0.77) (Figure 3).

***Economic returns*:** For economic returns as a constraint of the renewable energy systems adoption, the farmers moderately assessed that (3.63±0.56) which took the first position among constraints (Figure 2). The highest assessment was for the adoption of renewable energy systems as a constraint for the improvement of the economic returns (3.68±0.73). The second constraint was for increasing farming efficiency (3.59±0.84) and the least assessment as a constraint was for increasing practiced activities (3.45±0.85) (Fig. 3).

***Adoption tendencies*:** The adoption tendencies were moderate among the farmers (3.61±0.57) reserved the third position among constraints (Figure 2). The highest factor that affects the adoption of renewable energy systems is the type of farming (3.74±0.78), followed by the adoption of more technology in farming (3.65±0.77). The third factor that

affected the adoption was the willingness to adopt these systems (3.63±0.71). The fourth factor that increases the tendency to adopt the renewable energy system is the increase in farming investments (3.58±0.78) and the last one is for adopting the innovation in farming (3.47±0.97) (Fig. 3).

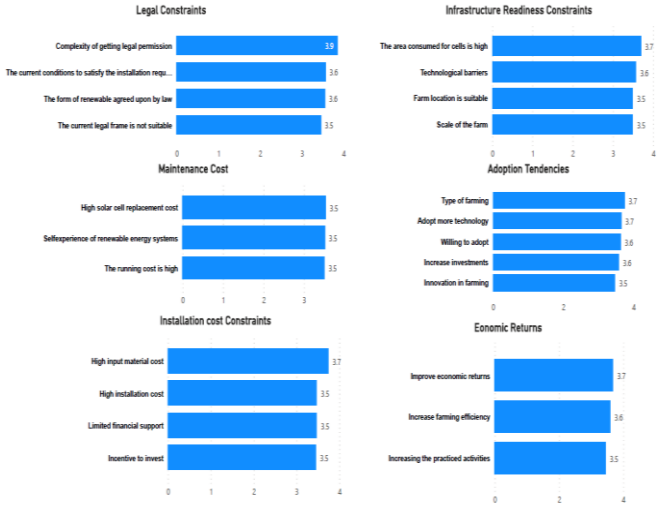

Figure 3. The farmers' trends for the different barriers within each constraint to adopt RES.

***Relative importance of constraints*:** Table 3 shows the relative importance index of the renewable energy system adoption constraints among the farmers. The results show that the legal and economic returns form the first constraint of adoption the of renewable energy systems (0.73). The second important constraint was for the readiness of the infrastructure (0.72). The third group of constraints includes the installation and maintenance costs with RIF (0.71) (Table 3).

***Association of Adoption Constraints*:** Figure 4 shows the association of constraints of adopting renewable energy systems. Table 4 shows the different criteria of the model. The results show that the model Chi-sq was 187.182 and the model was significant ($p<0.01$). Also, the results show that the relative Chi-sq to Df, RMSEA, GFI, AGFI, SRMR, IFI, and CFI are within accepted the range. Table 5 shows the correlation factors of the different constraints of adopting renewable energy systems. The results show that the highest correlation was between the legal and the installation cost constraints (0.284), followed by the legal and the infrastructure readiness (0.240), then the legal constraints versus the economic returns (0.219). The correlation between the economic return constraints and the maintenance costs was high (0.224). The correlation between the installation costs and the maintenance costs was 0.212. The least correlation was between the legal and the maintenance costs constraints (0.190) and the legal versus the economic returns (0.183) (Fig 4 and Table 5).

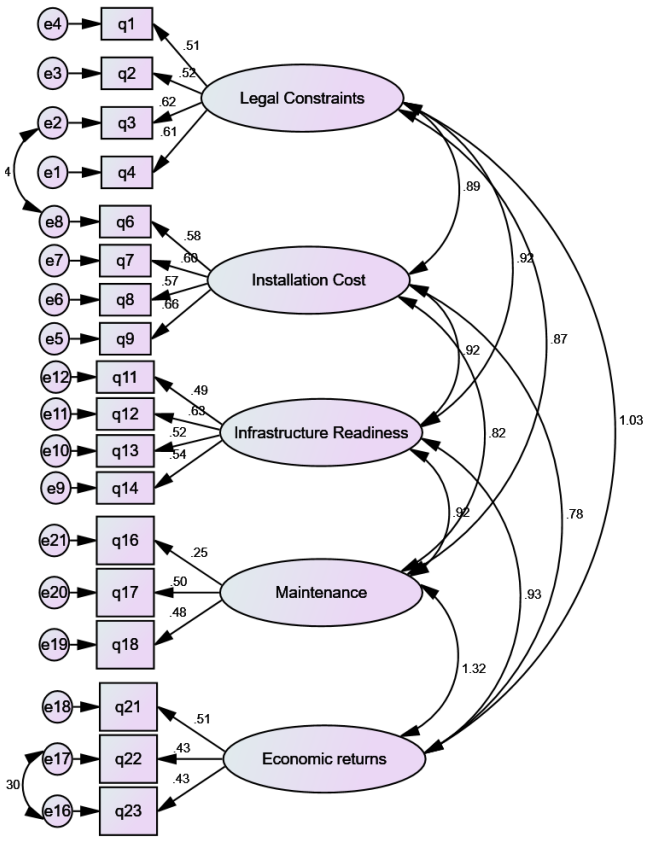

Figure 4. The interaction among the economic constraints of adopting the RES

Table 4. The model fitness criteria for the economic constraints.

Fit index	Limit	Value	Acceptability
Relative Chi-Sq to DF	>0.05	1.522	Accepted
RMSEA	<0.07	0.050	Accepted
GFI	>0.90	0.911	Accepted
AGFI	>0.90	0.876	Accepted
SRMR	<0.08	0.073	Accepted
IFI	>0.90	0.925	Accepted
CFI	>0.90	0.922	Accepted
Ch-square		187.2	
Prob		0.001	

***The effect of the constraints of adopting renewable energy systems and the tendency to adopt renewable energy systems*:** Fig. 5 represents the structural equation modeling (SEM) for the effect of the constraints of adopting the renewable energy system on the tendency to adopt renewable energy systems. The results show that the relative Chi-sq to Df, RMSEA, GFI, AGFI, SRMR, IFI, CFI are within the accepted range (Table 6).

Table 5. The interactions among the economic constraints facing the adoption of RES.

Constraint			Estimate	S.E.	C.R.	P
Legal	<-->	Installation cost constraints	.284	.055	5.194	***
Legal	<-->	Infrastructure readiness	.240	.050	4.846	***
Legal	<-->	Economic returns	.219	.049	4.439	***
Installation cost	<-->	Infrastructure readiness	.274	.053	5.171	***
Installation cost	<-->	Economic returns	.204	.047	4.326	***
Infrastructure readiness	<-->	Economic returns	.183	.044	4.162	***
Legal Constraints	<-->	Maintenance costs	.190	.047	4.056	***
Installation cost constraints	<-->	Maintenance costs	.212	.049	4.304	***
Infrastructure readiness	<-->	Maintenance costs	.202	.047	4.262	***
Economic returns	<-->	Maintenance costs	.224	.052	4.276	***

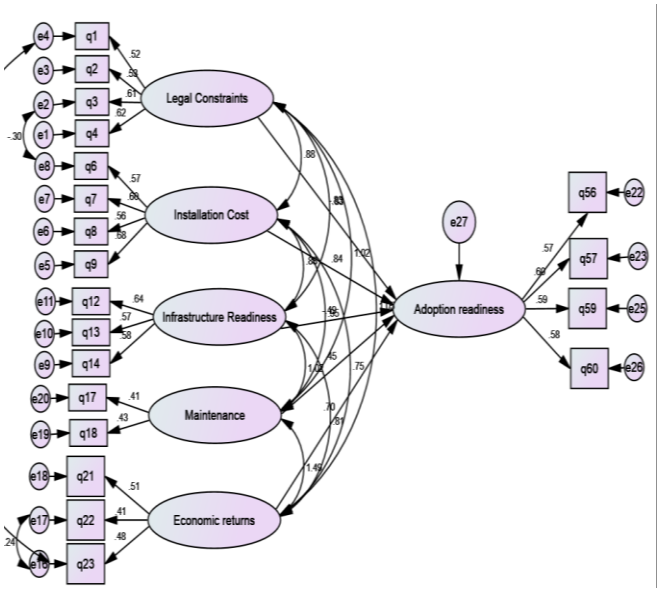

Figure 5. The effect of different constraints on the adoption of renewable energy sources.

Table 7 shows that the legal constraints have a negative impact on the adoption tendencies of renewable energy systems (-0.741). Also, infrastructure readiness has a negative impact on the adoption tendencies of renewable energy systems (-0.455). The positive effect was for the maintenance cost, the economic returns and the installation costs on the adoption tendencies (0.545, 0.805, and 0.661; respectively).

Table 6. The criteria of the effect model of constraints on the adoption of renewable energy sources.

Fit index	Limit	Value	Acceptability
Relative Chi-Sq to DF	>0.05	1.466	Accepted
RMSEA	<0.07	0.048	Accepted
GFI	>0.90	0.905	Accepted
AGFI	>0.90	0.900	Accepted
SRMR	<0.08	0.071	Accepted
IFI	>0.90	0.929	Accepted
CFI	>0.90	0.927	Accepted
Ch-square		222.8	
Prob		0.001	

Table 7. Regression Weights: (Group number 1 - Default model).

			Estimate	S.E.	C.R.	P
Adoption tendencies	<---	Legal	-.741	2.265	-.327	.744
Adoption tendencies	<---	Installation cost	.661	1.249	.529	.597
Adoption tendencies	<---	Infrastructure readiness	-.455	1.057	-.430	.667
Adoption tendencies	<---	Maintenance costs	.545	1.295	.421	.674
Adoption tendencies	<---	Economic returns	.805	1.038	.775	.438

DISCUSSION

The energy highly affects the life patterns in rural areas. The fluctuation of energy prices has a high effect on agricultural production and rural economies (Mehta, *et al.*, 2021). Solid energy policies and sustainable strategies will help regulate people's lives in rural areas and sustain agricultural production. On the other hand, the adoption of new energy sources is considered one of the radical changes in rural areas. Such change is expected to have a high objection. Such a change will change the life and the economic patterns of the rural areas. The governmental practices and the announced policies would help the rural areas to react more positively to the change process.

The objective of this study is to investigate the constraints that affect the adoption of renewable energy systems and their effect on the tendency of farmers to adopt these systems. The study aimed to measure the trends of the different constraints in general despite the size of the farms. The results show that the farmers' sample included farmers of middle and old ages with education BSc and middle to high experience. This enables the reflection of good experiences and knowledge on the evaluation of the constraints of using renewable energy systems.

The legal framework is considered the initiative of the use of renewable energy systems. Permission for the installation of renewable energy sources should be available before starting

the installation process. Unless there is governmental financial support, the farmers will tolerate all the installation costs. The analysis of the governmental regulations for the adoption of RES will facilitate and encourage the use of these systems in the agricultural sector. The installation costs and the fees of the permission form high overburden for farmers especially the small farmers. The lack of a governmental agreement will pause the process of adopting renewable energy sources. This justifies the high RII given for the legal constraint to adopt renewable energy sources. The installation costs can be minimized in case of increasing the adoption of these systems among farmers. Pascaris *et al.* (2021) recommended the revision of the laws that regulate the adoption of renewable energy sources especially in rural areas to change the social belief about renewable systems and to encourage such adoption. Devine-Wright (2011) investigated that the change of the policies and regulations will form the start to change the social-political acceptance of renewable energy systems.

The results showed that the current legal frame is not suitable to encourage the use of renewable energy sources. The farmers, also, have shown that to use renewable energy sources they should meet the requirements needed for that. One of the basic requirements depends on the location of the farm from the public electricity network. The farmers return to the complexity of the procedures to get permission as the original constraint to adopt renewable energy. The legal frame should consider the procedures followed to issue the permissions. These procedures should change to encourage the farmers to adopt renewable energy systems. Choobchian *et al*. (2018) have shown that legal constraints are considered crucial in facilitating access to renewable energy systems. The lack of legal frames for RES adoption especially in the agricultural sector will direct the investigation of the proper legal frame that encourages the distribution of RES among farmers.

Infrastructure readiness is considered the second constraint that affects the adoption of renewable energy systems. One of the main infrastructure requirements is the closeness of the farm to the public electricity network. The lack of closeness will limit the possibility of being connected to the public electricity network in the case of small farms. The other factor is related to the land level and the area of the farm. The lack of enough farm spaces would form a barrier to having solar radiation renewable energy systems. When the energy needs of the farm increase the space required will increase to meet the requirements. Moreover, the technology barrier is considered one of the constraints. The farmers show that they are not capable of this technology related to the maintenance and the requirements. This may form a new overburden for farmers in the short run. The knowledge improvement of farmers of these systems will teach the farmers about the saving of these needs over time and improve the adoption of such systems.

The installation cost forms a new barrier for the farmers. The previous experience showed that if the farmers receive financial aid in this regard, they would be encouraged to adopt this new technology for producing energy. The farmers especially the small ones expect that the government would introduce financial and technical assistance for them to adopt renewable sources of energy. One of the experiences shows that the farmers were highly encouraged to use renewable energy systems if the government took over all the installation costs as equipment or technically. The long-run experience was not evaluated due to the limited periods of adopting such systems.

Most of the farmers lack knowledge about the running needs for the maintenance of renewable energy systems. The farmers expect that the financial need to maintain these systems is high due to their lack of any previous experience. Even though, the farmers do not expect any financial aid in the maintenance efforts to sustain the production of energy using renewable sources. All these factors make the farmers feel that the maintenance cost is one of the barriers.

On the other side referring to the core of the farming business, the farmers expect that the new energy renewable systems would create savings or improve the production process to improve their business. The farmers' expectations of the contribution of the adoption of new renewable energy systems in the economic return are not high. This belief reflects the way farmers see these new systems as an overburden for them only. The shortening in introducing the benefits and the supervision of the governments will restrict the adoption of renewable energy technologies by farmers.

The distribution of the renewable energy systems in the rural areas in general and among farmers should be based on integrated plans including the adoption of laws and regulations that facilitate the reachability of farmers for these systems. The other important issue is related to the financial concerns of these systems. The government should adopt a strong financial aid system to facilitate the farmers to join these systems. Moreover, the governments should provide the necessary technical advice to help the farmers adopt and use these systems to replace traditional energy sources. The different results call for the need to direct the research to investigate the best practices that can be applied to encourage adoption, minimize the cost, and increase awareness of the maintenance issues of these systems.

***Conclusion*:** The objective of this study is to investigate the obstacles that face the adoption of renewable energy systems by farmers in rural areas. The study collected the different constraints from the literature review and the pilot study conducted for this purpose. The questionnaire was used to collect data. The study included farmers of different sizes. The results of the study showed that legal and economic constraints form the first barriers to adopting renewable energy systems in rural areas. The infrastructure and

installation constraints were less than the legal and economic returns constraints but still, they are of high consideration. The results showed that the expectation of farmers for the economic returns of these systems is not high. The farmers expect that these renewable energy systems will form an overburden for them in the short and long run. The study recommends a deep investigation of the legal frames for the adoption of RES to improve farmers' attitudes toward adoption. The knowledge programs for farmers in different agricultural production sectors will increase their awareness of reducing the cost of adoption and improve their experience in maintaining and sustaining the RES systems.

***Authors' contributions*:** Jawad Atef Al-Dalaeen completed this work himself including data collection, analysis, and writing the paper.

***Funding*:** This work is funded by the author himself

***Ethical statement*:**The consents were approved before the farmers contribution in this study

***Availability of data and material*:** I declare that the submitted manuscript is my work,
which has not been published before and is not currently being considered for publication elsewhere?

Acknowledgement:I thanks the farmers' contribution and encouragement to this work.

***Code Availability*:** Not applicable

***Consent to participate*:** Not applicable

***Consent for publication*:** I submitted consent to publish this research article in JGIAS.

REFERENCES

Abban, A. R. and M. Z. Hasan. 2021. Revisiting the determinants of renewable energy investment - New evidence from political and government ideology. Energy Policy151:1-12.

Afsharzade, N., A. Papzan, M. Ashjaee, S. Delangizan, S. Van Passel and H. Azadi. 2016. Renewable energy development in rural areas of Iran. Renewable and Sustainable Energy Reviews 65:743-755.

Babatunde, O. M., I. H. Denwigwe, O. S. Adedoja, D. E. Babatunde and S. L. Gbadamosi. 2019. Harnessing renewable energy for sustainable agricultural applications. International Journal of Energy Economics and Policy 9:308-315.

Choobchian, S., M. Ghorbannezhad and H. Farhadian. 2018. Analysis of Barriers to the Development of Renewable Energy Technologies at the Farm Level: A Farmer's Perspectiv. Journal of Rural Research 9:308-323.

Devine-Wright, P. and B. Wiersma. 2020. Understanding community acceptance of a potential offshore wind energy project in different locations: An island-based analysis of 'place-technology fit.' Energy Policy 137:1-14.

Hernandez-Escobedo, Q., D. Muñoz-Rodríguez, A. Vargas-Casillas, J. M. Juárez Lopez, P. Aparicio-Martínez, M. P. Martínez-Jiménez and A. J. Perea-Moreno. 2023. Renewable Energies in the Agricultural Sector: A Perspective Analysis of the Last Three Years. Energies 16:1-17.

Holcomb, Z. C. and K. S. Cox. 2018. Internal Consistency and Cronbach's Alpha. Interpreting Basic Statistics. pp. 223-225.

Hoyle, R. 2016. Handbook of structural equation modeling. Handbook of Structural Equation Modeling, 690-704. Retrieved from http://methods.sagepub.com/reference/encyc-of-research-design/n69.xml

Karbo, R. T., L. J. Frewer, F. Areal and E. Yu. 2022. Using renewable energy to meet the energy needs of smallholder farmers: Are there policies to promote adoption in Ghana? Ghana Journal of Agricultural Science 57:15-29.

Makki, A. A. and I. Mosly. 2020. Factors affecting public willingness to adopt renewable energy technologies: An exploratory analysis. Sustainability (Switzerland) 12:2-11.

Mehta, K., M. Ehrenwirth, C. Trinkl, W. Zörner and R. Greenough. 2021. The energy situation in central asia: A comprehensive energy review focusing on rural areas. Energies 14:1-27.

Meya, J. N. and P. Neetzow. 2021. Renewable energy policies in federal government systems. Energy Economics 101:1-14.

Morris, W. and R. Bowen. 2020. Renewable energy diversification: Considerations for farm business resilience, Journal of Rural Studies 80:380-390.

Pascaris, A. S., C. Schelly, L. Burnham and J. M. Pearce. 2021. Integrating solar energy with agriculture: Industry perspectives on the market, community, and socio-political dimensions of agrivoltaics. Energy Research and Social Science 75:1-36.

Roberts, S., T. Roland and A. S. Amarasekara. 2023. Factors affecting renewable energy technology adoption policies of 50 states and district of Columbia in the USA. Clean Technologies and Environmental Policy 25:211-219.

Santika, W. G., M. Anisuzzaman, P. A. Bahri, G. M. Shafiullah, G. V. Rupf and T. Urmee. 2019. From goals to joules: A quantitative approach of interlinkages between energy and the Sustainable Development Goals. Energy Research and Social Science 50:201-214.

Simpson, G. 2018. Looking beyond incentives: the role of champions in the social acceptance of residential solar energy in regional Australian communities. Local Environment 23:127-143.

Tsangas, M., A. A. Zorpas and M. Jeguirim. 2022. Sustainable renewable energy policies and regulations, recent advances, and challenges. Renewable Energy Production and Distribution: Recent Developments. Pp. 449-465.

Wright, P. 2011. Place attachment and public acceptance of renewable energy: A tidal energy case study. Journal of Environmental Psychology 31:336-343.

Zimmer, Y. and G. V. Marques. 2021. Energy cost to produce and transport crops – The driver for crop prices? Case study for Mato Grosso, Brazil. Energy.pp. 225:1-9.